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REPORT NO. 642.6/16

1/2" MONEL METAL (LTF)

EXPERIMENTALLY WELDED H-BEAM

BY

W. L. WARNER

AUGUST 12, 1936

WATERTOWN ARSENAL
WATERTOWN, MASS.

Test. Lab.

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Report No. 642.6/16

Watertown Arsenal

1/2" Monel Metal (LTF)

Experimentally Welded H-Beam

Aug. 12, 1936

This report covers the construction, heat treatment, and test of a welded H-Beam of 1/2" Monel metal plate (LTF). The plate has the following physical properties (letter C. A. Crawford, May 13, 1936).

Tensile strength	-	95,500 lbs./sq.in.
Proportional Limit	-	54,500 lbs/sq. in.
Elong. in 2"	-	25%
Red. of Area	-	64.2%

This plate was produced with a low temperature finish.

Welding

The form of the H-Beam is shown by Fig. #1,2, and 6.

Three pieces of plate were sheared approximately 28"x6". One of these pieces formed the web and the other two the flanges as shown in the figures mentioned. The triangular flange stiffeners shown were sheared approximately 3"x 2 3/4" and were twelve in number.

The H-Beam was completely assembled and tack welded together before welding was started. There was no machined fit

between any of the parts. The tack welds were placed at the ends of the web and at the ends of the legs of the triangular flange stiffeners.

Welding was performed with a 5/32" diameter Monel electrode (Inco #130-X), and the fillets were all 2 layer, 1/2" fillets. The triangular flange stiffeners were welded first to the flanges all around and then to the web; the first layer being applied all around on all stiffeners before the second layer was applied. The piece was positioned for each weld because it was not feasible to weld with this electrode unless the welding can be done in the "flat" position or very nearly flat.

Approximately 150 amperes and about 25 volts, reversed polarity (electrode positive) across the arc were used throughout.

When the triangular flange stiffeners had been completely welded the flanges were welded to the web with the same sequence of layers.

Distortion and Heat Treatment

After welding was completed and the structure had cooled to room temperature the four bays were stamped with the numbers 1,2,3, and 4 as shown by Figures #1,2, and 6 and measurements from outside to outside were made

to denote the distortion of the flanges in the center of the bays. The measurements (as welded) are as follows:-

1	2	3	4
6 19/32"	6 19/32"	6 5/8"	6 3/4"

The flanges of bays #2 and #3 were straightened cold and the measurements then were -

6 19/32"	6 27/32"	6 25/32"	6 23/32"

The H-Beam was then given a stress relieving treatment by being heated to 575°C and held for 3 hours followed by a furnace cool.

After stress relieving the H-Beam was sand blasted and measurements were again taken as follows:

6 19/32"	6 27/32"	6 25/32"	6 23/32"

These readings indicated no change of shape during stress relieving of the structure.

The welds on the H-Beam were then X-rayed completely and the specimen was sent to the machine shop for machining.

Machining and Distortion

The H-Beam was set up on a planer and a cut of approximately 1/8" was taken across the face of both flanges and along each edge of each flange. Immediately following machining the dimensions of the piece from outside to outside and from inside to inside of the flanges were taken by a shop inspector.

These measurements were taken on Friday August 7, and after laying over the week end the measurements were repeated on Monday, August 10. There was no change of dimension detected to the nearest thousandth.

Testing

On Monday P.M., August 10th, the specimen was tested in the laboratory by loading as shown in Figure #6.

A pronounced yielding started at between 170,000 and 175,000 lbs., load by buckling of the top flange in compression. The structure stood a maximum load of 213,000 lbs.

The specimen after test is shown by Figures #3, 4, and 5. Figure #5 shows the sideways movement of the beam.

It is significant that even though the weld fillets have been bent and stretched longitudinally and transversely, there is no evidence of weld failure.

On the basis of a simple beam bending under a load concentrated at the center and neglecting the stiffening effect of the flange stiffeners at the center and the weld fillets, also, the apparent stresses at the outer fibers of the flanges are as follows, as calculated by the Engineering Department:

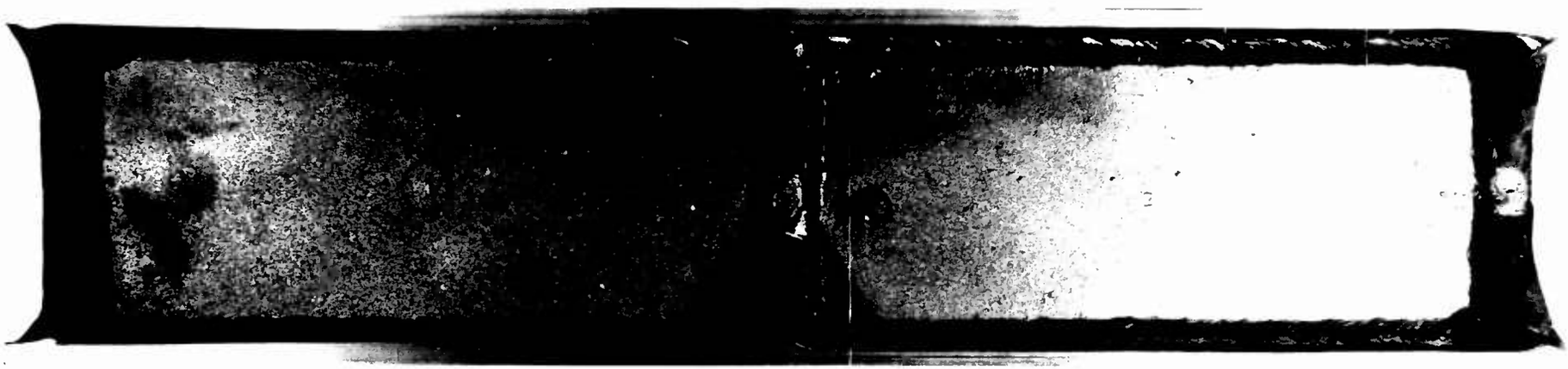
Load	Stress
175,000 lbs.	77,924 lbs/sq.in.
213,000 lbs.	94,845 lbs/sq.in.

These stress values are of course higher than actual because without the stiffening effect of the triangular flange stiffeners or weld fillets, the load sustained would have been lower. If we assume this load to have been 25% lower, then the stresses actually may have been as follows:

Load	Stress
Yield	58,440 lbs/sq.in.
Ultimate	71,100 lbs/sq.in.

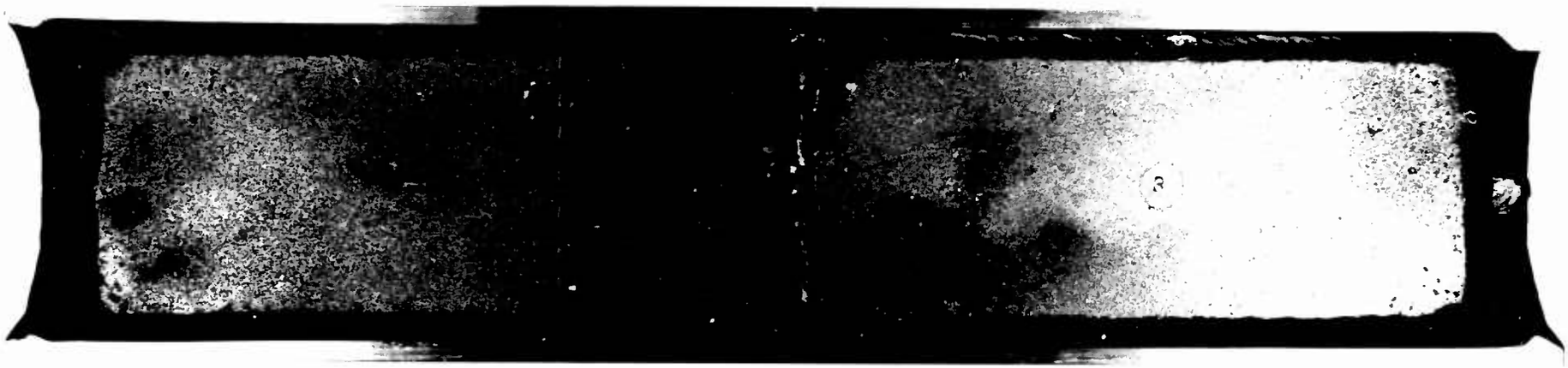
Respectfully submitted,

W. L. Warner,
Welding Engineer.



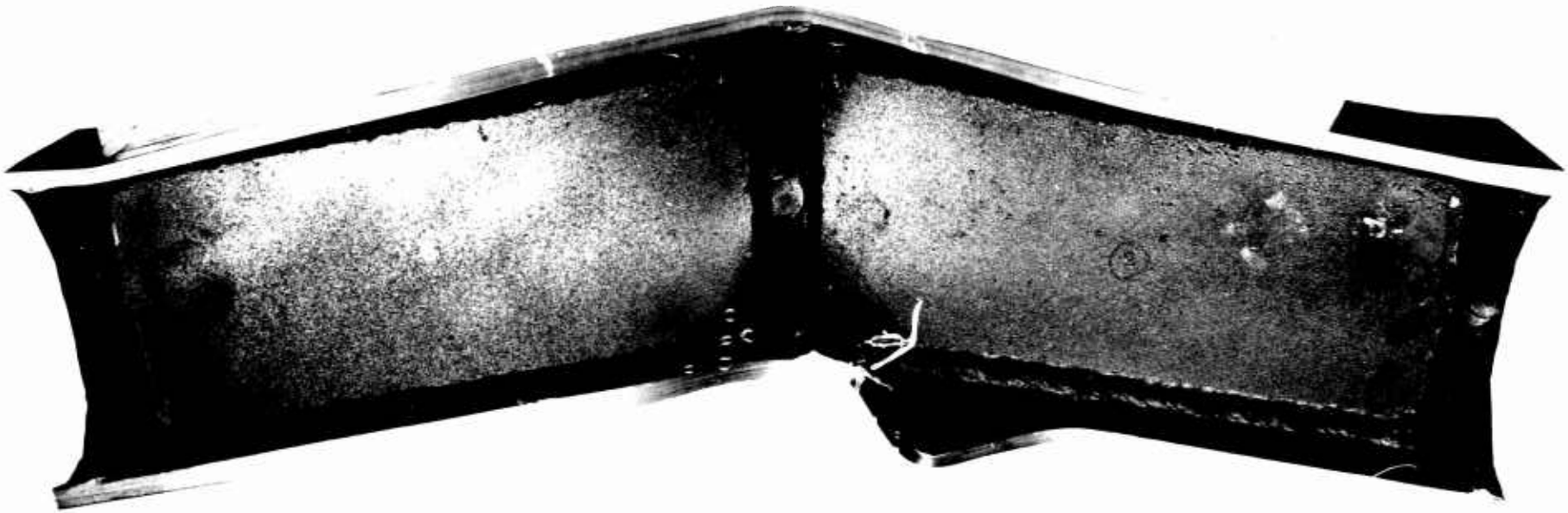
Experimental Welded "H" Beam 1/2" Monel Plate
(ITF) Max. Load 217,000# X0563-A7 WA121-347

FIG. #1



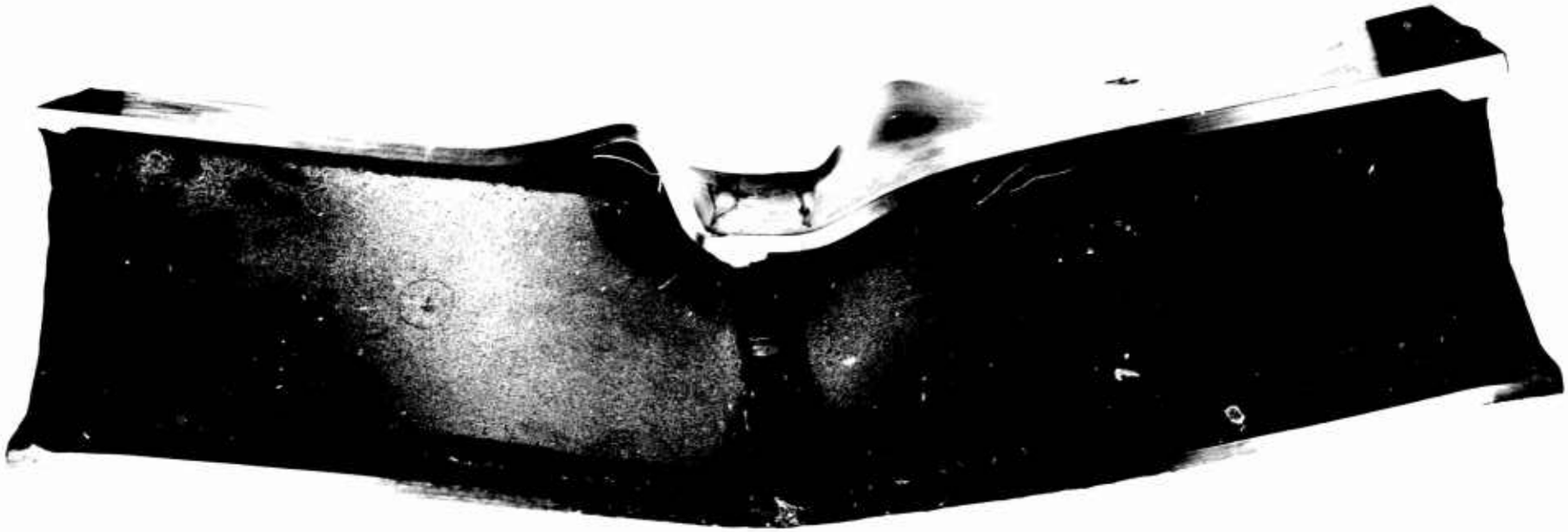
Experimental Welded "H" Beam 1/2" Monel Plate
(LTF) Max. Load 213,000# X0563-A7 WA161-344

FIG #2



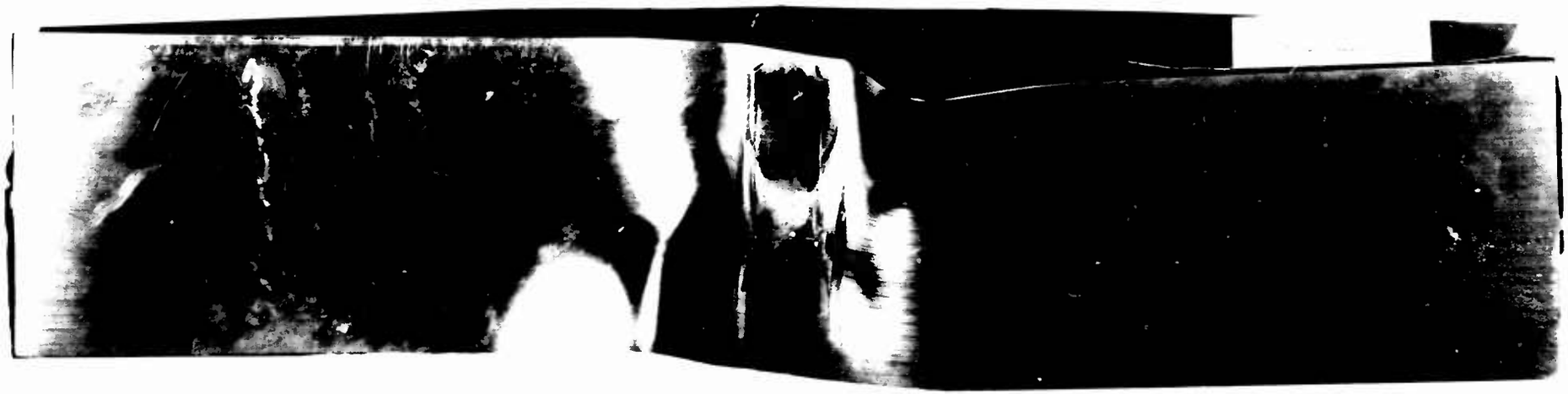
Experimental Welded "H" Beam 1/2" Monel Plate
(LTF) Max. Load 213,000# X0563-A7 WA121-345

FIG #3



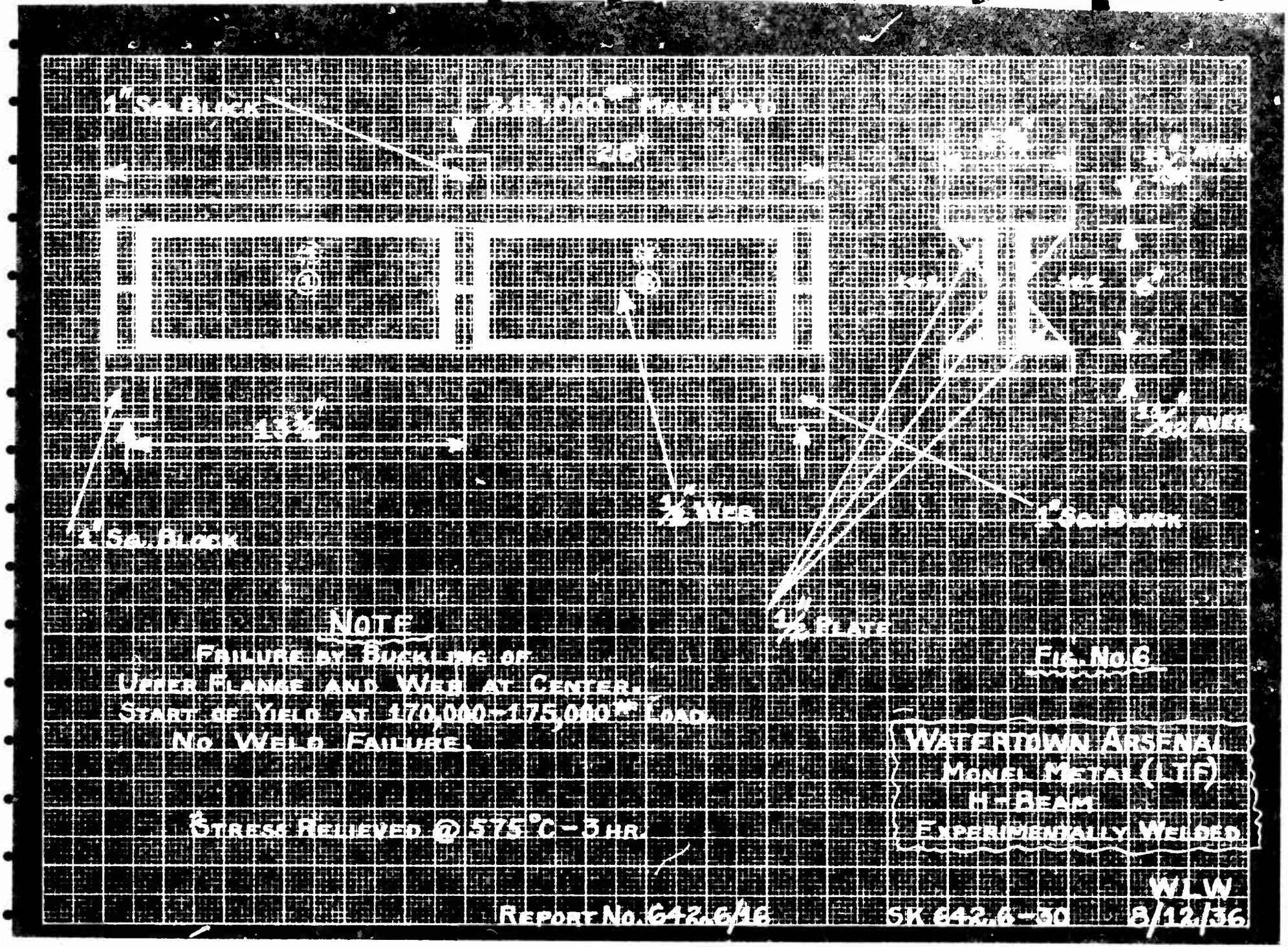
Experimental Welded "H" Beam 1/2" Monel Plate
(LTF) Max. Load 213,000# X0563-A7 WA121-346

FIG #4



Experimental Welded "H" Beam 1/2" Monel Plate
(LTF) Max. Load 213,000# X0563-A7 WA121-347

FIG #5


1 Sq. Block
1 Sq. Block
1 Sq. Block
1 Sq. Block
1/2 Web
1/2 Web
1/2 PLATE
1/2 PLATE
NOTE
FAILURE BY BUCKLING OF
UPPER FLANGE AND WEB AT CENTER.
START OF YIELD AT 170,000-175,000# LOAD.
NO WELD FAILURE
STRESS RELIEVED @ 575°C - 3 HR.
Fig. No 6
WATERTOWN ARSENAL
MONEL METAL (5%)
H-BEAM
EXPERIMENTALLY WELDED
REPORT No. 642.6/18
SK 642.6-30
WLW
8/12/36